SPARKS, WAVES, & WIZARDS:
Communications at Sea

EXHIBIT CONCEPT PLAN

June 1998

San Francisco Maritime National Historical Park

Prepared by
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NATIONAL HISTORICAL PARK
Exhibit Department

for

Mr. Ken Richardson

and the

National Maritime Museum Association

DESIGN CONCEPT PLAN

09.35 (158976)

COMMUNICATIONS EXHIBIT — *DESIGN CONCEPT PLAN*

Our goal is to produce a dynamic radio communications exhibit which engages visitors with compelling interactives and quality artifacts.

THEMES

1. HISTORY OF MARITIME COMMUNICATIONS
2. RADIO ON THE BAY TODAY
3. EXPLORING RELATED ACTIVITIES

OBJECTIVES

Interpretive

❋ Generate interest in and promote understanding of maritime communications; past, present and future.

❋ Use social history as a foundation for interpretive media in order to tell stories of individuals and technology.

❋ Use a wide variety of hands on/interactive exhibit components which take advantage of state of the art technologies.

❋ Develop programs that encourage participation from the antique wireless community.

❋ Become a resource for individuals and schools seeking knowledge on the topic of maritime communications.

❋ Maximize the interpretive potential of the active bay view.

❋ Highlight critical historical developments through intuitive interactives that are easy and enjoyable to use.

❋ Ensure that the information/interpretation is clearly presented and relevant to the visitor.

❋ Conduct formative and summative evaluations with our visitors to ensure success.

Supportive

❋ Develop a curriculum based interpretive program that allows school groups to gain maximum educational value from the exhibit.

❋ Produce a traveling version of the exhibit.

❋ Provide an adjunct exhibit, in another location within the museum, which accommodates visitors with disabilities.

❋ Provide for ongoing repair and maintenance of interactives.

❋ To the extent possible, provide a docent/ranger in the exhibit area.

RECOGNITION

Feature an article on the exhibit and the donor in the Sea Letter
(National Maritime Museum Association's Magazine)

Exhibit opening by invitation

THEMES/EXHIBIT ELEMENTS

COMMUNICATIONS EXHIBIT — *THEMES/ELEMENTS*

An orientation area includes a mural of early San Francisco Bay blending into a view of a satellite in space providing a visual context for entire exhibit (the past, present, and future of maritime communications). A written and oral version of the introduction provides an overview of maritime communications.

THEMES (and supporting exhibit elements)

1. HISTORY OF MARITIME COMMUNICATIONS

Provides an historical context which focuses on the different methods of communication used between 1850-1950

–Antique spark gap radio (recreation)
–Graphic panels highlight the key people and significant developments
–Interactive semaphore exhibit
–Interactive "radio through the ages" headset exhibit gives the visitor listening/learning choices (oral histories, factual information, the airwaves — between 1850 and 2000)
–4 Unit Victory ship radio (real, possibly working, Victory ship radio unit)
–Interactive signal light

2. RADIO ON THE BAY TODAY

Capitalizes on the spectacular bay view to interpret the different kinds of traffic coming through the Golden Gate today and how radio is used to control it

–Graphics/images and text about the various kinds of shipping traffic on the bay
–Interactive radar unit shows live bay traffic activity on the screen
–Interactive radio direction finder
–Fathometer/fathometer recorder
–Sound bubble/s tuned to live radio stations (vessel traffic reports)
–Live radio for exploring different stations
–Chart table with chart of the bay and an exercise for determining vessel locations
–Telescopes and "big eyes" for self-guided exploration of the bay

3. EXPLORING RELATED ACTIVITIES

Invites visitors to explore activities which promote greater understanding of maritime communication

–Computer stations with related Internet sites (VTS and P.O.R.T.S)
–Interactive "Radio through the ages" headset exhibit
–Morse code interactive
–Wave theory interactive/s
–Signal flag activity
–Analog vs. digital interactive

WALKTHROUGH

COMMUNICATIONS EXHIBIT — *WALK THROUGH*

ORIENTATION

As you walk up the stairs to enter the exhibit, you hear an unusual recording of sounds that you may recognize as Morse code. Many visitors will hear only the sound but those who know the language of morse code will understand the greeting which invites them to enjoy the exhibit and to share their knowledge and interest in radio with other visitors. A translation of the message will be in print.

(Visitors may flow through the space in any way they chose. An orientation exists for those who feel more comfortable with some background information).

As you enter the exhibit space, to your right, there will be a large historic photo mural of ships on the San Francisco bay in 1850. A text panel provides a brief written introduction to the exhibit. In the same location, overhead, is a sound dome which, if activated, provides you with an oral version of the text. The sound is localized and is heard only by visitors standing under the dome.

1. HISTORY OF MARITIME COMMUNICATIONS

Continuing around to the right, on the back side of the mural, is a complete recreation of a spark gap radio from around 1917. A bench at the desk encourages you and a companion/child to sit down and investigate further. The headsets, placed in a visible location, encourage interaction with the exhibit. When you put on the headset, you hear a recording of an actual spark gap transmitter popping and crackling. A spark arcs across the gap in the coils in the exhibit (which corresponds to the sound you are hearing). Written text here describes spark gap radio and uses the Titanic story as an example.

Below the windows, and at a comfortable viewing height, are a series of graphic panels which have photos, graphics and text. One may be about Jack Binns, the famous heroic radio operator who "saved" the crew and passengers of the *Republic* in 1909. Guglielmo Marconi, credited with the invention of wireless radio would surely be included here. Another panel could describe the bay area before radio.

The semaphore interactive exhibit is in this area. As you approach an upright stand with outstretched perpendicular arms, you notice a larger, identical looking device directly outside on the deck. As you intuitively move the arms of the exhibit indoors, you see that the larger version of the device outdoors is moving in the exact same way. An exhibit panel illustrates the different arm positions and describes their meaning. The text invites you to send a semaphore message to Hyde Street Pier (where there is another semaphore interactive exhibit that can be used by visitors on the pier). School children may break up into groups and send messages back and forth. The history and significance of Telegraph Hill and Point Lobos is explained in the text.

There is a related optical communication interactive exhibit nearby–the signal light. Like the semaphore, it can be used to send messages to Hyde Street Pier, where an identical signal light is stationed allowing for a dialogue between Museum and Hyde Street Pier visitors.

An exhibit panel with an attached pair of binoculars invites you to use the binoculars to examine the signal flag message on the CA Thayer. In this area, around the walls, is the alphabet in signal flags. There may be scrap paper and pencils to assist you in deciphering the message. The messages will change weekly and will vary in complexity.

An actual Victory ship radio will undoubtedly be the most impressive artifact in the exhibit. A bench in the location where the radio officer would have done his job will put you in the shoes of the radio operator. The headsets will play recreations of historic messages that were sent by way of tube type radios. Since these would all be in Morse code, there will need to be some method of translating (perhaps the typewriter could be rigged like a player piano to print out messages as you are hearing them). A number of personal stories and historical accounts will be part of a recording that details the essential lifeline provided by the work of the radio operator.

An interactive "radio through the ages" exhibit, which encompasses all of the themes, provides a transitional space into the following theme area. Benches on either side of a freestanding radio allow a group of people to use the exhibit. There are two headsets at each exhibit. The controls are easily recognizable/identifiable and the information is divided first by decade (beginning in 1900 going up to the year 2000). You can turn the knob to a decade and within that chosen decade, select from three different recordings (oral histories, factual information, "airwaves") of that time period.

2. RADIO ON THE BAY TODAY

The spectacular view of the bay from this area will compel you to activate an audio "tour" which describes what you are viewing and "where things are". Like the orientation, this will be a discreet sound dome that will only be heard if you are standing underneath it. There will be graphic panels detailing the view and labeling the landmasses, landmarks, and aids to navigation. On your right is a large mural describing (with photos and text) the many types of ships in the bay today so that you can identify them as they go by. A chalk board (or some simple method of record keeping) allows you to record what you see and to share your recordings with other visitors. There will be a telescope and some "big eyes"/ binoculars to identify far away ships.

A live radio (with headsets) will allow you to listen to live traffic signals coming from ships on the bay. By listening to the radio and using the binoculars, you may be able to identify the ships whose signals you are listening to. A text panel located within view will contain a vocabulary of radio terminology and formalities making the radio jargon more accessible.

Another way to view the ships as they come through the bay is through the radar screen. A radar dish, located in ideal position to pick up signals, will receive the entire scope of view. A text panel will describe radar and its relationship to radio. The radar will be a modern day type (used on ships today).

A chart of San Francisco bay is on a chart table in this area. A number of exercises at this location will address the essentials of navigation. A large graphic and text above the chart table describes the activities step by step. A radio direction finder will be above the chart table. You can turn the wheel to activate a recording that describes the use of RDF. A built-in monitor on the wall behind the chart table plays a looped videotape of bar pilots navigating the bay.

A stand-up version of the earlier interactive "radio through the ages" exhibit provides a transitional space.

3. EXPLORING RELATED ACTIVITIES

A bank of computer stations backs up to the chart table wall. Live Internet sites are available for browsing. The first is the Vessel Traffic Service site which has up to date visuals and information regarding vessel traffic in the bay. The second site is the Physical Oceanographic Real-time system (P.O.R.T.S.), which provides up to date information regarding winds and currents, observed vs. predicted tides, water temperature, and more. A bench will allow more than one visitor at a time.

The physical space that the following interactive exhibits occupies will be defined by the exhibits themselves. This area will contain a number of interactives designed to explain:

1. How radio works (exhibits on wave theory)
2. Changes in technology and ramifications for the future (analog vs. digital technology)
3. Morse code exercises/activities
4. Signal Flag activity

Along the satellite mural wall is an interactive laser disc that contains clips from television and movies that have to do with maritime radio (familiar clips that scan across all different time periods...WWII movies, Star Trek, etc....) The idea is to give/leave people with a real feeling of familiarity with and connectedness to the world of maritime communications. Spanning the entire length of the mural wall are the words "SPARKS, WAVES AND WIZARDS: Communications at Sea".

SIGNAL FLAGS

INTERNATIONAL FLAGS AND PENNANTS

ALPHABET FLAGS			NUMERAL PENNANTS
Alfa — Diver Down; Keep Clear	**Kilo** — Desire to Communicate	**Uniform** — Standing into Danger	1
Bravo — Dangerous Cargo	**Lima** — Stop Instantly	**Victor** — Require Assistance	2
Charlie — Yes	**Mike** — I Am Stopped	**Whis-key** — Require Medical Assistance	3
Delta — Keep Clear	**Novem-ber** — No	**Xray** — Stop Your Intention	4
Echo — Altering Course to Starboard	**Oscar** — Man Overboard	**Yankee** — Am Dragging Anchor	5
Foxtrot — Disabled	**Papa** — About to Sail	**Zulu** — Require a Tug	6
Golf — Want a Pilot	**Quebec** — Request Pratique	REPEATERS 1st Repeat	7
Hotel — Pilot on Board	**Romeo**	2nd Repeat	8
India — Altering Course to Port	**Sierra** — Engines Going Astern	3rd Repeat	9
Juliett — On Fire; Keep Clear	**Tango** — Keep Clear of Me	CODE — Code and Answering Pennant (Decimal Point)	0

EXHIBIT DEVELOPMENT PROCESS

Museum Exhibition Development Process

Can a team of people collaborate to create a meaningful, rewarding, and entertaining experience for museum visitors?

Basic Parameters:

Time: The scope of the project reflects the amount of time available to complete the work. Coordinating the timing of various deliverables is critical and requires frequent and ongoing communication between the museum development team and the independent firms involved with the project.

Budget: Good design is possible whether the budget is large or small, as long as the work is scaled to fit the available funding. Translating the budget into feasible and manageable project parameters will require establishing goals and performance criteria and then prioritizing the museum's needs and desires based on these criteria.

Approvals: Developing an approvals process is essential to a smooth running project. Who will have the final authority to make decisions? How will the interests of the design team, the museum staff, the institution, and the other stakeholders (including visitors) be represented?

Roles & Responsibilities: Determining each individual's role and responsibilities is equally important. This should be decided before work on the exhibition begins. However, it's impossible to fully predict everyone's role up front. What's needed is a clear system for making decisions and incorporating changes, so that each person's role can evolve as the project progresses. The key is establishing ground rules for working together and keeping everyone informed of changes as they occur.

The following is an ideal process to plan and design an interpretive exhibition. This process will be modified to accommodate the specific project.

Deliverables are in **bold**.

Phase I: Start-Up (Are there rules?)

- Determine core work team, advisors and community representatives.
- Develop a preliminary schedule, budget, approvals process, and scope of work.
- Create a contract or letter of agreement.
- Decide how the stakeholders involved will work together. (ground rules)
- Review any previous studies (such as way finding, attendance, evaluation, or marketing studies) to get a broad picture of the museum, its visitors, and its relationship with the surrounding community.
- Conduct a literature review to gain a better understanding of the public's knowledge of and interest in the exhibition topic.

Phase II: Concept Design (What is our vision of the exhibition?)

- Determine the target audience. (Who is it for?)
- Establish a **mission** or purpose. (Why are we doing it?)
- Establish **communication goals.** (What do we want visitors to remember?)
- Refine the theme or **main message.** (What is it about?)
- Select the **content** (image/object research and preliminary selection) and **supporting messages** that will communicate the main message.
- Prioritize the **supporting messages.** (What is most important?)
- Organize the content into a sequence or **story line.**
- Create a **bubble diagram** that maps the messages into the desired space.
- Begin creating the proposed "**look and feel**" of the exhibition (graphic and environmental concept perspective sketches, interactive/activity concepts, audio/video concepts, "voice" concepts)
- Conduct **front-end evaluation** studies to assess visitors' interest in and knowledge of the main message. The results of these studies are used to refine the content and focus of the exhibition.
- Conduct team meetings (6-10) **brainstorming** messages.
- Determine preliminary **budget.**
- Prepare and schedule **presentations** for approvals and/or fund-raising.
- Get **approvals** in writing.

Phase III: Design Development (What will visitors experience?)

- Create a design and production **schedule.**
- Develop plans and sketches (**schematic floor plan** and **elevations**) that depict the two- and three-dimensional media and proposed environments.
- Create a 3-D scale model of the exhibition.
- Create a **components list** with reproductions; include measurements, condition, and sources.
- Create and test **mockups** (**formative evaluation**) and **prototypes** of labels and interactive displays. (Will it work?)
- Create **text outline** for wall graphics and audio/video script/ music.
- Design **architecture, graphics, interactives, lighting.**
- Consider ADA, security, durability, safety of visitors and artifacts.
- Plan **audio/video programs.**
- Proof, edit, translate **drafts** and **final text.**
- Conduct ongoing content and design review to assure that all decisions support the main message. (Don't go off on tangents)
- Finalize **plans** and **elevations.**
- Research and development of exhibit techniques, products, materials, technology.
- Specify **equipment** and **materials.**
- Estimate fabrication **costs.**
- Conduct team meetings (8-12) to complete planning.
- Prepare and schedule **presentations.** (reviews/approvals/revisions)

Phase IV: Construction Documentation (How are we doing it?)

- Complete final drawings and specifications for the **bid-ready package**. (package includes floor plans, fabrication detail drawings, materials and color specifications, audio/video hardware and software specifications, lighting and reflected ceiling plan, electrical plan, graphics (images, text, illustrations)
- Create **mock-ups** and **prototypes** as needed.
- Develop specific exhibit technology.
- Collect fabrication contractor **bids**.
- Conduct team meetings (3-6) for reviews/approvals; interview fabricators.

Phase V: Fabrication & Installation (Who builds it?)

- Select and contract with fabricators.
- Review and approve **shop drawings**.
- Oversee fabrication and installation.
- Approve **change orders** and revisions.
- Purchase equipment, materials, and supplies.

Phase VI: Remedial Design (Does the exhibition work?)

- Set aside time and money to complete this phase.
- Conduct **summative evaluation studies**
- Use the results of these studies to adjust the design and label text of those elements that did not communicate the intended message or that proved difficult for visitors to operate.
- Conduct regular **maintenance** and **repairs**.

How can we do all of this, maintain quality control, be creative, avoid compromise, and have fun?

Ground Rules (created by my JFK University Museum Studies graduate students)

Create a Safe Environment
- Respect all ideas and thoughts; trust each other's abilities; allow team members to finish speaking without interruption or criticism.

Maintain Professionalism
- Keep meeting minutes, and rotate responsibility for this; set meeting agendas and goals; rotate responsibilities for meetings, and respect them;maintain professional behavior and mature attitudes; discuss issues internally before sharing outside the group; make meetings meaningful and necessary.

Take Care of Ourselves
- Set aside check in and break time during meetings; respect other's lives outside of school; ask for help when needed.

SITE VISITS

COMMUNICATIONS EXHIBIT — *SITE VISITS*

SUISUN BAY MOTHBALL FLEET

We have taken a trip out to Suisun Bay (the mothball fleet) to investigate the condition of the equipment on board all nine Victory Ships (radio and navigation). We took photographs and notes with an eye toward removing the equipment for purposes of repairing and exhibiting it (in working order). We have sent a letter to MARAD requesting a transfer of the above equipment (not yet a specific part by part list) to get the ball rolling.

VESSEL TRAFFIC SERVICE, YERBA BUENA ISLAND

We visited the VTS (Vessel Traffic Service) on Yerba Buena Island and reviewed current as well as future technologies, for monitoring/controlling traffic in the bay. We found that some of the programs are accessible over the Internet and could be easily installed with the proper hardware.

VALLEJO MARITIME ACADEMY

We "experienced" the bridge simulator at the Vallejo Maritime Academy where students are trained to pilot modern day vessels. A visual recreation of the bay is projected onto five screens which form a semicircle. Many different conditions can be simulated to teach different skills. The lessons are mostly navigational. We have continued access to their extensive maritime library.

RESOURCES/CONTACTS

COMMUNICATIONS EXHIBIT — *RESOURCES/CONTACTS*

INDIVIDUALS

Tom Horsfall
Subject Matter Specialist-tube technology
(510) 237-9535 after 4pm.
1862 Tulare Avenue
Richmond, CA 94805

Bart Lee
Subject Matter Specialist-spark gap radio
(415) 956-5959 X103, FAX 362-1431

Don Koijane (pronounced Cojane)
(650) 473-6467, FAX (650) 473-6468

Will Jensby
President —Perham Foundation
(408) 296-6071, FAX (408) 296-3224
W0E0M@aol.com

Kevin Foster
Chief Maritime Historian NPS
(202) 343-5969

Roy Couzin
RCouzin@aol.com (Sparks Journals)
(408) 335-7874

Larry Kellogg
Volunteer —JPShaw Library
Our chart collection/navigation

August Link
(760) 437-4420
Spark gap radio parts and information.

Duey Livingston
Publishing radio history for Pt Reyes
KPH Pt Reyes radio station
663-9047 (home #)

ORGANIZATIONS

American Radio Relay League
225 Main Street
Newington, CT 06111
(203) 666-1541

Perham Foundation
Historical Radio Organization
(408) 734-4453

Society of Wireless Pioneers
P.O.Box 86
Geyserville, CA 95441-0086
Acting President—Waldo Boyd (707) 857-3434
KGDZY@netdex.com

Antique Wireless Association
Village Green
Route 5 & 20
Bloomfield, New York
(716) 657-6260

Antique Wireless Association
Curator— Ed Gable
187 Lighthouse Road
Hilton New York, 14460
(716) 392-3088
KZMP@eznet.net

Columbia River Maritime Museum
Director—Jerry Ostermiller
1792 Marine Drive
Astoria, Oregon 97103
(503) 325-2323 FAX (503) 325-2331

New Wireless Pioneers
Elma, NY
(716) 681-3186

MARAD (Maritime Administration)
Fleet Superintendent—Joe Pecoraro
Suisun Bay Reserve Fleet
PO Box 318
Benicia, CA 94510
(707) 745-0487 FAX (707) 745-2508

Vessel Traffic Service
Scott Humphreys
(415) 556-0861
FAX 6-6851
Internet address: vtssf.netwiz.net

Marine Exchange
Bruce Clark **441-6600**

P.O.R.T.S
Physical Oceanographic Real-time System
(707) 642-4337
web page: www.sfmx.org

1995 VISITOR STUDY SUMMARY

Visitor Services Project
San Francisco Maritime National Historical Park
Report Summary

- This report describes part of the results of a visitor study at San Francisco Maritime National Historical Park (Hyde Street Pier/ Maritime Museum) during August 19-26, 1995. A total of 825 questionnaires were distributed. Visitors returned 578 questionnaires for a 70% response rate.

- This report profiles San Francisco Maritime visitors who visited the Hyde Street Pier/ Maritime Museum. A separate appendix has visitors' comments about their visit; this report and the appendix contain a comment summary.

- Seventy-two percent of the visitors were in family groups. Forty-four percent of San Francisco Maritime visitors were in groups of two. Many visitors (40%) were aged 31-50 and 23% were aged 15 years or younger.

- Among San Francisco Maritime visitors, 18% were international visitors. One-fourth (25%) of those visitors were from Germany, 18% from the United Kingdom and 14% from France. United States visitors were from California (53%), New York (5%), Washington (4%) and 41 other states.

- In the past year, most visitors (92%) had visited once. When asked how often they had visiting during the past five years, most (83%) were visiting for the first time.

- Most visitors (78%) were not aware that Hyde Street Pier and the Maritime Museum are part of San Francisco Maritime National Historical Park.

- Many Hyde Street Pier visitors (83%) stayed one to two hours. Common activities on the Hyde Street Pier were visiting the historic ships (71%) and taking photographs (55%). Most visitors (88%) felt the Hyde Street Pier admission fee was "about right."

- At the Maritime Museum, 77% of the visitors stayed for an hour. The most common activities were visiting the first floor (64%), visiting the second floor (54%) and visiting the steamship room (46%).

- Over one-third of the visitors (36%) did not receive any information about San Francisco Maritime prior to their visit. Others relied on previous visits, travel guides/ tour books or area signs to learn about the park. Their reasons for visiting. were to board the historic ships and to learn maritime history.

- The forms of transportation that visitors used to get to the park were walking (52%) and private vehicles (49%).

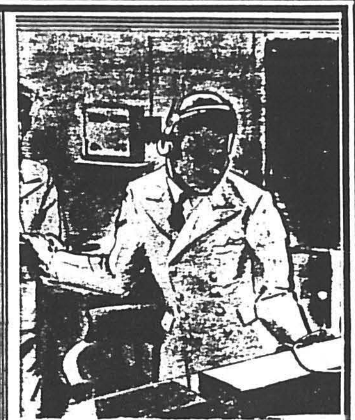
- The most used visitor services were the historic ships (71%), restrooms (64%), educational signs and museum exhibits (each 58%). According to visitors, the most important services were the historic ships (83%), educational signs (82%) and restrooms (82%). The service receiving the highest proportion of "not important" ratings was museum exhibits (10%). The best quality services were ranger-led tours (84%), historic ships (83%), staff assistance (83%), and educational signs (82%). The services with the highest "very poor" quality rating was the historic ships (9%)

- Most visitors (94%) rated the overall quality of services in the park as "good" or "very good." Visitors made many additional comments.

For more information about the Visitor Services Project, please contact:
Dr. Gary E. Machlis, Sociology Project Leader, University of Idaho Cooperative Park Studies Unit, College of Forestry, Wildlife and Range Sciences,
Moscow, Idaho 83844-1133 or call (208) 885-7129.

EARLY HISTORY

Development of Communications



By - Prof. Herbert J.Scott

Development of Communications

PART I

PRIMITIVE AND EARLY METHODS

From the beginning of history, men have struggled with the problem of communication between people some distance apart. Among the primitive people, fire and smoke signals were used. The aborigines of Africa used 'jungle drum' signals. These kinds of signals were used for centuries and all of them have played a part in the evolution of communications as we know it today. Historically, man's first recorded attempt at communication from a distance dates back some 3,000 years or more.

Homer, in the Illiad, describes the fire beacon as a method of communication. It signalled the Greek army that Ulysses and his men, who had entered Troy in the belly of the wooden horse had opened the gates of Troy so that the Greeks could enter and sack the city.

The great historian Herodotis tells that in 400 BC a signal was sent from Athens to Marathon (about 25 miles) by means of sunlight reflected from a soldier's highly polished shield.

It is also recorded that the Persians made use of both reflected sunlight in the daytime and beacon fires at night. The reliability of such signalling of course is dependent upon the conditions of sunlight and fog.

The Egyptian city of Alexandria, located at the mouth of the Nile, was founded by Alexander the Great in 332 B.C. Here in 300 B.C. was built the great lighthouse of Alexandria, one of the seven wonders of the world. Upon its top was a large reflecting mirror of burnished metal. This was for the purpose of signalling to ships at sea.

Now is we delve into the Bible, we find in Jeremiah 6:1 that it tells of the use of signal flares by the Jewish people:

> "Oh, ye children of Benjamin, gather yourselves to flee out of the midst of Jerusalem, and blow the trumpet in Tekoa, and set up a sign of fire in Beth-accerem: for evil appeareth out of the North, and great destruction!"

Tekoa was a town of Juda, six miles from Bethlehem, and now called Tekua. Beth-accerem was a beacon station near Tekoa.

In England communication by means of signal lights and fire beacons was widely used throughout the country up through the time of Queen Elizabeth (1600).

It was in the year 1588 that the Great Spanish Armada approached the coast of Great Britain intending to attack England and take it over for Spain. As a result of fire beacons blazing high into the sky from hill top to hill top, most all of England knew of the approach of the Armada. Realizing England to be thoroughly prepared for their proposed attack, the Spaniards chose the better part of valor and withdrew to the high seas from whence they had come.

The English poet Macauly, in describing the appearance of the Great Spanish Armada off the southern coast of England, wrote

> "From Eddystone to Berwick Bound, from Lynn to Milford Bay,
> That time of slumber was as bright and busy as the day.
> For swift to east and swift to west the ghastly war-flame spread
> High on St. Michael's Mount it shone, it shone on Beachy Head.
> Far on the deep the Spaniard saw, along each southern shire,
> Cape beyond Cape, in endless range, those twinkling points of fire."

At a still later date we had our own beacon light made famous by Longfellow in his immortal poem "Paul Revere's Ride." You may recall the following:

> "He said to his friend, 'If the British march
> By land or sea from the town tonight
> Hang a lantern aloft in the belfry arch
> Of the North Church tower as a signal light,
> One if by land, and two if by sea.'"

Later, and for many years to follow, the form of signal extensively used by the U.S. Army was the 'heliograph'. This word comes from the Greek helio meaning sun and graph meaning to write. So heliograph means literally, 'to write by the sun'. In 1890 the Army Signal Corps transmitted a signal by heliograph from one mountain peak to another over a distance of 215 miles!

In the 18th century shortly before the French revolution, a new system of communication was devised. It was called a 'semaphore system' and interestingly enough it was the result of a schoolboy prank wherein some schoolboys in two nearby schools devised a system so that they could send messages back and forth between the two schools.

The word semaphore comes from the Greek sema meaning 'a sign' and pherein meaning 'to bear' so literally semaphore means "to bear a sign."

The French government immediately applied the semaphore system to military signalling. In their system towers were erected every five miles or so. On top of each tower was erected the semaphore consisting of a mast on top of which were two movable arms, somewhat similar to our railroad semaphores.

The first semaphore message recorded in history was sent over the system on the 15th of August 1794, announcing the victory of the French arms over the Austrians. During Napolean's reign he extended the semaphore for a distance of 1,112 miles across France.

It was only natural that England, in order to keep abreast of the times, should install her own semaphore system of stations. However, they were not very satisfactory because of England's frequent dense fogs which prevented communication with London. And London was, and is, the nerve center of the nation.

Following the semaphore there were numerous other methods of communication devised: flags, colored lights, and many variations of these. All of them were relatively short lived, however.

The systems discussed here are all 'optical systems', they depend upon the ability of being seen for their success. In PART II we shall discuss the developments in electrical types of communications.

PART II

THERE WERE GIANTS ABROAD IN THE LAND

In the century following that of the beacon light and semaphore, where signalling was accomplished optically, we come to the era of the application of electricity to communications.

It was in 1837 that Samuel Finley Breese Morse, better known as Samuel F. B. Morse, invented and developed the electric telegraph.. Congress appropriated money for the construction of an experimental telegraph line extending from Baltimore to Washington. Miss Annie Ellsworth, the daughter of the Commissioner of Patents, brought the news of the appropriation for the experimental line to Morse. He was so delighted with the news that he told Miss Ellsworth that she could frame the first message to be sent over the wires.

When the line was completed in May 1844, Miss Ellsworth, a deeply religious young woman, chose the now famous message, "What hath God wrought" which she selected from the Bible, Numbers 23:23.

However, man was never completely satisfied with the telegraph, as wonderful as it was. He always wnated to be able to transmit the human voice and speech.

It was in the year 1876 that Alexander Graham Bell first achieved success with his telephone: the transmission of information by the human voice. In the original experiment speech was carried by a pair of wires extending from upstairs in his house to the basement.

Now, in spite of all of this progress, man was limited insofar as he must either be limited by the extend of the visual horizon for optical transmissions, or he must be tied to his transmitting location by a pair of copper wires. This, as is quite apparent, posed a serious restraint of motion. So, if these connecting wires could be eliminated, a whole new dimension would be introduced into communication.

In 1865, James Clerk Maxwell, a brilliant mathematical physicist, of Scotch ancestry, wrote his now famous and profound mathematical essay on the electromagnetic theory of light. As a result of this analysis he came to the conclusion that electrical impulses travelled through space in the form of waves, similar to light waves, and with the same velocity as light. This was really the ovum from which came wireless after a long, long period of gestation.

Some twenty-two years later, in 1887, a young German physicist by the name of Heinrich Hertz succeeded in transmitting electromagnetic waves across his small laboratory. He was later able to observe the effects at a distance of several hundred feet. He also showed that they obeyed the laws of optics by reflecting them from metal mirrors, by focusing them through lens shaped cylinders made of pitch, thereby confirming Maxwell's predictions. These Hertzian waves as they were called became the subject of widespread experiments in all countries.

In 1892, Sir William Crooks indicated in a magazine article that it should be possible to utilize these waves to telegraph across space.

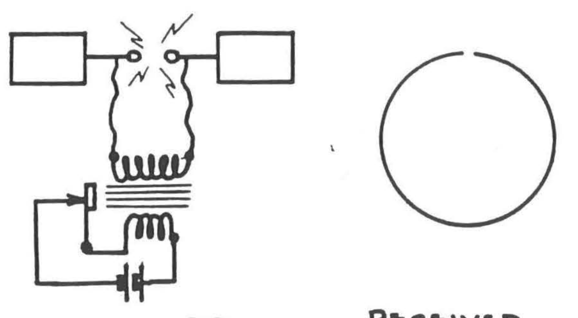
It is interesting to note that in 1885, both Edison in this country and Sir William Preece in England, came close to the practical utilization of electromagnetic radiations. Edison had covered the top of a railroad car with tin foil and was able to pick up signals from telegraph wires which ran alongside of the railroad track while the train was in motion. The system proved impracticable, however, because the signals picked up were all of the signals being transmitted over all the wires. Sir William Preece at this same time built a large square of copper wire one quarter of a mile on a side. Separated from this square by a quarter of a mile was another similar square of copper wire. In making and breaking the current in the first loop, he was able to observe the effects in the second loop.

Visualizing Hertzian waves as a medium of communication a young Italian man by the name of Guiglielmo Marconi developed a system of communication utilizing them. Young Marconi of Italian-Irish parentage was born in Bologna, Italy, on April 25, 1874. He was the son of a wealthy farmer and studied physics at Leghorn University under Professor Rosa who taught the science of electricity. He further pursued the subject under Professor Righi at the University of Bologna.

At the age of 18, having read the essay by Crookes, who you remember suggested the possibility of wireless telegraphy, he became greatly impressed with the predictions Crookes made. Then and there young Marconi made it his life ambition to perfect and establish wireless communicatior throughout the world.

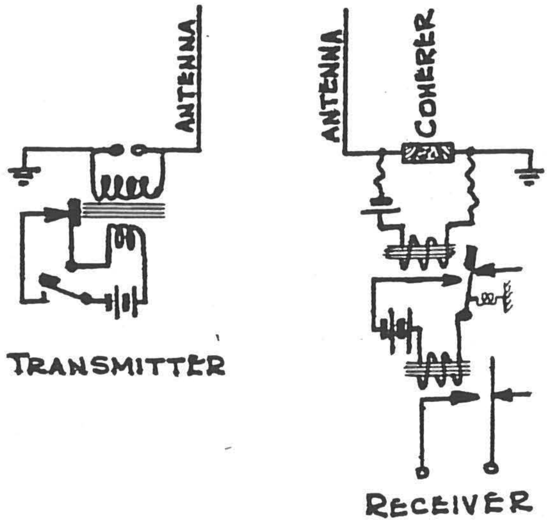
Marconi's first experiments were carried out on his father's farm, across the rows of cabbages and corn. In his system he replaced the dipole radiating system of Hertz with a connection to ground and a connection to an elevated wire which he called an 'antenna'. To this he connected his transmitter. The wire loop receiver of Hertz he replaced with his antenna and ground connected to a coherer for his receiver. With these modifications and the insertion of a telegraph key he was able to send a message over a distance of a mile or so. This was phenomenal at that time ! (Circuit diagrams below show the evolution and development in the mode of wireless communications during its early years).

Evolution of . . . the 'Wireless'



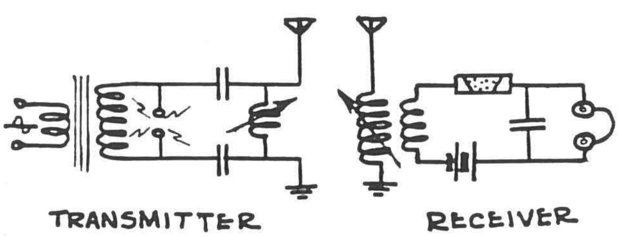
HERTZ (1887)

FIG. 1



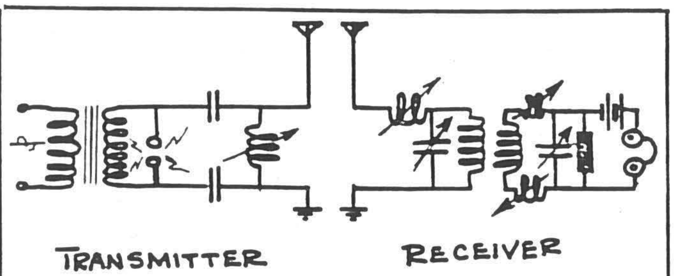
MARCONI (1896)

FIG. 2



SIR OLIVER LODGE (1898)
TUNING APPEARS HERE

FIG. 3



MARCONI (1901)
TUNING FROM LODGE USED HERE.

FIG. 4

In 1896, at the age of 22, young Marconi went to England and took out the first patent ever granted for wireless telegraphy to anyone, anywhere in the world. The following year, 1897, the British Marconi Company was formed with the 23-year old Marconi as its Chief Engineer.

The English scientist, Sir Oliver Lodge, aided Marconi materially in the period 1897-1898 by developing the principles of tuning wireless circuits, and hence, the technique of being able to send out and receive signals of a definite wave length was developed.

In 1899, at the request of the United States Navy Department, young Marconi came to this country to test his equipment on the battleships New York and Massachusetts. Communication was established between them for a distance of 36 miles. While here in this country on this mission, he formed the American Marconi Company. (It was my distinct pleasure to work for this company as a wireless telegraph operator until it was bought out by the newly formed RCA in 1919 after which I worked for RCA until I swallowed the anchor in 1924.)

So rapidly and effectively did Marconi and his engineers work that they were ready to try their experiment of transmitting a signal across the Atlantic by December of 1901.

In order that this experiment could be carried out a transmitting station was erected at Poldhu, a small town on the Cornwall coast of England. The receiving station was located at St. Johns, Newfoundland.

It was on December 12, 1901, that the first signal was transmitted by wireless across the Atlantic Ocean. The signal was the letter "S" consisting of three dots (...) repeated at stated intervals. And again reception was accomplished the following day, 13 December 1901. Scientists over the world had said that it could not be done! However, it WAS done! (Of course, at that time no one knew about the Heaviside Layer.)

In his lifetime he was asked many times if he invented wireless. His answer was always an emphatic 'no'. He simply took some of the ideas of Hertz, a number of practical ideas of his own, a few items from other workers and put them together in the proper form to produce a workable wireless telegraph system. He received many honors in his time including Italian Knighthood in 1897, the Nobel prize (jointly with Professor Braun) in Physics in 1909. In 1929 the Italian government bestowed upon him the title of 'Marquis'. In Rome, on the 20th day of July 1937, he journeyed to that mysterious realm from whose bourne no traveller returns. He was laid to rest at the age of 63.

It is inevitable that in a new field of scientific discovery and endeavor that there will sooner or later be attracted to it a considerable number of investigators.

One of these was Professor R. A. Fessenden of the University of Pittsburgh. Wireless was no stranger to him, as in 1900 the U.S. Weather Bureau hired him to carry out experiments regarding the utility of Wireless telegraphy as an aid in weather forecasting and storm warnings.

By this time Professor Fessenden had come to the following two conclusions: first some substitute for the coherer must be found which would function with much smaller signal inputs than the coherer did; secondly, a way should be found whereby the human voice could be reproduced at the wireless receiver.

From here on wireless telegraphy progressed fairly rapidly from the spark and crystal detector phase to the vacuum tube era which held sway for many years, to the transistor stage where we find ourselves today.

The day came when a major sea disaster took place and wireless telegraphy was called upon to play an exceedingly important part. As many of you like myself can well remember, and others of you have read or heard of it, the TITANIC, a beautiful, enormous, new ship, supposedly 'unsinkable' was on her maiden voyage from England to New York. She struck an iceberg and sunk with a loss of 1,607 lives. Many of these persons were very prominent and well known people. There were 706 people saved through the aid summoned by wireless. The year was 1912.

The operator at Wannamaker's New York store on watch at the time was a young fellow by the name of David Sarnoff who later on took over as the guiding hand of RCA.

It was this dramatic part played by wireless in this disaster that gave great public impetus to wireless telegraphy, which in their eyes, became the 'marvel of the century'. Wireless had then hewed a place for itself in the world of communication

About this time the U. S. Navy decided that 'wireless' telegraphy was a misnomer as it could be taken to mean all forms of communication without the use of connecting wires. Orders were thence issued that from this time on the term 'radio telegraphy' should be used. The American public accepted the name almost immediately. However, our British cousins hung on to the older term and in fact still do to a large extent today.

It was in 1903 that Fessenden patented his 'electrolytic' detector. This consisted of a very fine Wollaston wire which dipped into a 20% solution of nitric acid and water. It was by far the most sensitive device up to this time and, in addition, it was capable of reproducing the audio tone of the signal.

Now Fessenden wanted a high frequency alternator of about 100kHz to be connected directly to antenna and ground and resonated. As a means of developing Fessenden's inventions, the National Electric Signalling Company was formed.

In the year 1903 a machine was developed by Steinmetz and was built by the General Electrical Company for Fessenden. Its output was about one kilowatt at a frequency of 10 kHz.

In 1904, Fessenden requested the General Electric Company to develop and build for him an alternator which would be capable of producing an output of 100 kHz.

A young engineer and a newly hired member of General Electric's engineering staff by the name of E. F. W. Alexanderson was assigned the task of developing such a machine. A generator of 1 kw. capacity producing a frequency of 50 kHz was delivered to Fessenden September, 1906.

On Christmas eve of 1906, wireless operators aboard ship at sea many miles away were astounded to hear first, the voice of a man speaking, then a woman singing, followed by a violin solo, after which came a speech. This was followed by a request to all receiving stations which had heard the program to please communicate with Professor R. A. Fessenden, at Brant Rock, Massachusetts. This was the first broadcast of speech and music in history.

About this same time another worker in the field was soon to become famous for his unique contribution to wireless. In January of 1907, Dr. Lee DeForest, a young graduate of Yale, applied for a patent on a three electrode vacuum tube, which he chose to call an 'audion'. This device was ultimately to play the most important part in the area of communications that any device had ever been called upon to play. It opened up a whole new area of fantastic proportions. This little evacuated bottle probably came closer to being an 'Alladin's Lamp' than anything ever devised by the mind of man.

From whence did this little 'might might' spring? In 1883 Thomas A. Edison, in trying to find ways to improve his electric light, noted that when a small metal plate was enclosed within the lamp bulb and was connected to the positive side of the filament, current would flow in the external circuit leading to the plate. However, when the plate was connected to the negative side of the filament no current flowed in the external circuit.

Edison reported this phenomenon in the scientific journals. It was known thereafter as the 'Edison effect'! He then concerned himself with other matters which in his mind were more important at the time.

In 1897, fourteen years later, Sir James Ambrose Fleming, at this time one of Marconi's technical advisors, an English physicist, applied the Edison effect to the rectification or detection of wireless telegraph signals. His device became known as a Fleming valve, consisting of what we call today a diode.

It was this device to which DeForest added the third element which resulted in his 'audion'.

Now in 1907 DeForest organized the "DeForest Radio Telephone Company" in order to market his audion and develop wireless telephony.

In the summer of 1907 DeForest carried out a test of his system on Lake Erie. The U.S. Navy Department became interested in wireless telephony. When the 'Great White Fleet' made its journey around the world, there were over twenty of the ships equipped with DeForest's wireless telephone!

As a result of many popular magazine articles on the subject, a number of amateurs built their own wireless equipment. My first set was put up in 1912. Since there were at that time no regulations governing the operation of wireless equipment, neither with respect to wavelength or power, pandemonium reigned in the air waves. Interference became a terrific problem. At times when an interfering station was taken to task by a shore station, the answer often was simply a bunch of vulgar obscenities!

Occasionally, and with increasing numbers, a prankster would cause no end of confusion. For instance, naval vessels would receive orders, presumably from some Admiral sending them to the Philadelphia Navy Yard instead of their original destination, the Brooklyn Navy Yard!

Frequently impossible docking orders were sent to incoming ships, vessels would be diverted from their destinations and routed elsewhere. False distress calls would be sent out!

This was all possible because at that time there was no law to prevent such antics and nothing could be done to the perpetrators.

The U.S. Navy played an important part in the early development of wireless. Many systems were exhaustively studied and tested by the Navy and many inventors were financed by them. One of the greatest experimental stations in the early history of radio was the mammoth naval wireless station at Arlington, Virginia. With its 600 foot towers it was 3 years in the building and went into commission in February 1913.

Installed in this station, and each tested separately, were two rival systems. One was the 500 cycle, 100 KW synchronous rotary spark gap transmitter provided by Fessenden, and the other system was a 100 KW Poulsen arc, invented by Valdemar Poulsen of Denmark, and manufactured by the Federal Telegraph Company of San Francisco. In this test the arc system demonstrated greater coverage and much more freedom from static than did the spark system.

As a result of the foregoing tests the Navy used and tested arc transmitters in different sizes from 2 KW to 1,000 KW in its vessels and in its shore stations throughout the U.S., Panama, Hawaii, Guam, and Manila. At this same time the Navy was keeping a watchful eye on the Alexanderson alternator.

It was along about the early '20's that the spark and crystal detector gave way to the vacuum tube which occupied a position of preeminence for some years until the advent of the transistor which is with us today.

With the advent of WWII great strides were made in the radio field. Much of it of course was military in nature and use. For instance, RADAR, an acronym for Radio Detection and Ranging, was born. Without it we would have been in a much more difficult position than we were. It was used for many different purposes: for detecting the approach of planes, for detecting submarines on the surface, for detecting the presence of ships, for gun laying (gun laying is directing the fire in angular position and distance to the target), keeping track of ships in a large convoy, remember, they were all running on a zig-zag course without lights at night. Many more military developments took place, such as IFF (Identification of Friend or Foe); Countermeasures, Sonar, Radar Beacons, Sonobuoys, etc., etc.

A great deal of the above developments produced a tremendous knowhow with respect to pulse circuits that was of great help to Television as it exists today.

In the early development of television there were a number of systems proposed. Basically they divided themselves into two kinds. One was a mechanical scanning system, the other was an electronic scanning system. They both produced workable systems but the mechanical scanning had many disadvantages. To produce a picture such as we have today, would take an enormous scanning disc, the peripheral speed of which would have to be in the danger area, to say nothing of the noise such a device would create! Fortunately the electronic system of scanning prevailed. Prior to WW II the television system we had used 441 lines per picture frame, as of today we have a finer line structure which uses 525 lines per picture frame.

When color TV came in, the FCC made a very sensible ruling to the effect that whatever system was used for color, non-colo sets must be able to receive the picture in black and white without degradation.

It is my own personal and candid opinion that it will not be too long before we will be able to see TV in three dimensional pictures, based on the application of Holography to the system.

PART III

FEUDIN' AND FIGHT'N

When WW I began, all the powers involved directed their attention towards the military importance of radio communication. Practically all of the stations in this country were taken over by the United States Government. At the same time every amateur station was ordered closed down completely. Most of the equipment was stashed away in the attic for the 'duration'.

An officer of the Signal Corps of the U.S. Army, in the spring of 1918, was stationed in France. His name was Armstrong and his rank that of Major. He was assigned the job of developing a very sensitive receiver with which it would be possible to listen in on the German front line radio network. As a result of his efforts to produce such a receiver, he invented the system for which he is well known - the superheterodyne system!

As it happened, radio and Major Armstrong were old friends. Along about 1913 or so, he was a penniless student trying to put himself through Columbia University and to continue his experimental work with the audion. In fact, at this particular time, he was working on the ideas of feedback systems. However, he was severely handicapped financially. Fortunately, he was able to convince Professor Pupin of Columbia that in the course of his investigations he had discovered a most valuable principle, that of regeneration! Professor Pupin was a great help to him so that in October of 1914, Armstrong was awarded a patent on this circuit.

Now in the winter of 1918 the U.S. Navy had finished the installation of a 200 KW Alexanderson alternator at New Brunswick, N.J. At that time it was the most powerful transmitter in the world. Operating with the call letters NFF it could be heard all over the entire world. To those of you who remember hearing it, it had a beautiful clear, clean tone.

When the sudden ending of WW I came, quite unexpectedly, chaos reigned in the radio industry. With the ending of the war, radio communications in this country were still under the absolute control of the U.S. Navy!

At this time, President Wilson was gravely concerned with the possibility that the British might dominate world wide radio communication. It was a well known fact that the American Marconi Company had been incorporated with British money. In order to checkmate this, Admiral Bullard, who was then the Director of Naval Communications, requested a conference with the administrators of the General Electric Company. As a result, the General Electric Company agreed to create an all-American corporation to be called the "Radio Corporation of America."

The RCA was granted a charter in October, 1919, under the corporate laws of the state of Delaware.

It was on the 20th day of November, 1919, that the RCA bought out the interests of the American Marconi Company. On this day the American Marconi Company ceased to exist and the RCA took over.

Not only did RCA take over all of the ship and shore stations which had belonged to the American Marconi Company, but also ownership of the Marconi Telegraph and Cable Company, The Wireless Press, and the Pan-American Wireless Telegraph and Telephone Company was acquired. In addition, it entered into a cross-licensing agreement with the General Electric Company.

Like many other firms and industries, the Westinghouse Company of Pittsburgh also found itself hard hit by the sudden cessation of the war. Westinghouse decided therefore that if it was to be able to continue its international reputation as a great electrical manufacturing company, it was of the greatest importance that it also should take a vigorous part in the radio business. They adopted a policy of operation, following this decision, that today we would call "muscling in" on RCA!

The International Radio Telegraph Company was located in the city of Pittsburgh. This company was the successor to the original National Electric Signalling Company of Professor Fessenden. It so happened that at this time it was in a financial straight jacket. Westinghouse bailed it out of its troubles financially and as a result, entered into a cross-licensing agreement with it.

Unfortunately for Westinghouse, however, the International Company could not compete all the way with RCA because it completely lacked the essential parts of an entire system! International had no efficient transmitter and in attempting to overcome this dilemma, an agreement was entered into with the U.S. Government whereby the company was able to secure the license to use any and all Government held patents including the Poulsen Arc patents!

Additionally, Westinghouse entered into negotiations with and finally bought Armstrong's regenerative receiver patents. This turned out to be a most propitious deal inasmuch as now Westinghouse had a trading advantage with RCA. The result was that RCA would now be obliged to enter into trade negotiations in order to avoid complications.

In the meantime, RCA completed a cross-licensing agreement with the A.T. & T. Co. As a result, G.E. CO., A.T. & T., RCA, and Western Electric Company were all tied together by cross-licensing agreements. The next move on the part of the RCA was to obtain cross-licensing agreements with the United Fruit Co. and with the Wireless Specialty Co.

The G. E. Co., while the war was in progress, had been turning out very, very expensive radio equipment such as the Alexanderson Alternator. With the coming of the armistice, the war patronage was suddenly cut off and the G.E. Co. soon be obliged to dismiss a large number of skilled workers.

It was not long before the General Counsel for the British Marconi Company came to the G. E. Company and placed an order for 24 Alexanderson Alternators at a cost of $127,000 each. G.E. might have accepted the offer except that it was coupled with conditions that the G.E. Co. refused to accept. What they wanted was exclusive rights to the Alternator. To this G.E. countered with a proposal to supply the alternators on a royalty basis. This the Marconi Co. said "NO" to. Then the Marconi Co. was offered the machines outright and were then to pay $1,000,000 bonus in lieu of royalty.

However, just at this time, the G.E. Co. received a letter from the Navy Department. As a result, following this letter between Owen D. Young of the G.E. Co. and Admiral Bullard, an agreement was reached between the two to the effect that the G.E. Co. would not sell the alternators to the British Marconi Co.

TIMELINE/COST ESTIMATES

COMMUNICATIONS EXHIBIT — *ESTIMATED COSTS/TIME*

ESTIMATED COSTS

Initial

900 square feet of exhibit space X 250.00/sq. ft. = $225,000.00

Additional

Curriculum based education program..........................$5,000.00
Traveling exhibit..$20,000.00
Adjunct exhibit (handicap accessible)......................$10,000.00
Repair/maintenance...$5,000.00/year

ESTIMATED TIME

Additional concept design— 60 days
Design Development— 120 days
Fabrication/Installation— 180 days